

REMARKS

None of the claims have been amended in this application. The Examiner is requested to reconsider this application, in light of the following remarks.

Applicants assert that the present invention is different from the Suzuki invention and the Hiroaki invention, as discussed below.

Claim Rejections under 35 USC §103

Claims 1 and 2 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Japanese Patent Application 01-239350 to Hiroaki, in view of Japanese Patent Application 11-063694 to Suzuki.

Claims 3-5 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Japanese Patent Application 01-239350 to Hiroaki, in view of Japanese Patent Application 11-063694 to Suzuki.

Japanese Patent 11-063694 to Suzuki

Japanese Patent 11-063694 to Suzuki describes a refrigeration cycle. The Suzuki invention includes a compressor (2), a radiator (3), an evaporator (7) and a gas liquid separator (5). A sensor (10) is attached to the gas liquid separator (5) which is in turn connected to a control unit (11). The control unit (11) is also connected to a first throttle valve (4). A bypass passage (9) leads from the gas liquid separator (5) to the compressor (2).

Although the refrigerant is made to be in the supercritical state by the compressor, the

refrigerant in the gas state, after the gas-liquid two-phase state, is returned to the compressor as can be seen from the line shown from point C to point G (see Fig. 3).

Japanese Patent 01-239350 to Hiroaki

Japanese Patent 01-239350 to Hiroaki describes a refrigerating cycle device. The Hiroaki invention includes a compressor (10 and 12), a condenser (2), an evaporator (4) and two expansion valves (3 and 11). When the temperature of the compressor (10) rises the expansion valve (11) is opened to enable the cooling of compressor (12).

Originally, the refrigerant in the critical state is not used, and as can be seen from Gc showing the injection (it is also explained in the specification that Gc of Fig. 2 corresponds to Gc of Fig. 1), the refrigerant in the liquid state is returned to the compressor after changing the state of the refrigerant from the gas-liquid two-phase state to the gas state (see Fig. 2).

The present invention

The present invention is a refrigerator in which two embodiments are described. The first embodiment is shown in Figure 1 and recited in claims 1, 2 and 5 and the second embodiment is shown in Figure 3 and recited in claims 3 and 4. The first embodiment consists of a compressor (21), a radiator (22), an evaporator (24). A temperature sensor (28) is placed on the line leading from the compressor (21) and measures temperature of the carbon dioxide refrigerant leaving the compressor (21). A control unit (29) is connected to the temperature sensor (28) and is also

connected to a second throttle valve (27). As indicated on page 7, lines 9-18 of the specification the discharge gas temperature from the compressor (21) is measured by the temperature sensor (28) and when the temperature exceeds a preset temperature the control unit (29) opens the second throttle value (27) which permits refrigerant in a supercritical state flowing out of the radiator (22) to be injected into the cylinder of the compressor (21).

The second embodiment of the present invention is shown in Figure 3 and described on pages 8-13 of the specification. The second embodiment of the present invention includes a compressor (21), an outdoor heat exchanger (31) and an indoor heat exchanger (32). A temperature sensor (28) is placed on the line leading from the compressor (21) and measures temperature of the carbon dioxide refrigerant leaving the compressor (21). A control unit (29) is connected to the temperature sensor (28) and is also connected to a second throttle valve (27). As indicated on page 10, lines 21-31 the discharge gas temperature from the compressor (21) is measured by the temperature sensor (28) and when the temperature exceeds a preset temperature the control unit (29) opens the second throttle value (27) which permits refrigerant in a supercritical state flowing out of the outdoor heat exchanger (31) to be injected into the cylinder of the compressor (21).

As to the present invention, "an injection pipe is connected to a cylinder of said compressor not via a receiver for separating gas and liquid from each other, and the refrigerant in the supercritical state is injected into said cylinder of said compressor". That is to say, the phrase "the refrigerant in the supercritical state is returned to the compressor" is recited in the independent claims. Since the refrigerant in the supercritical state is returned to the compressor, even if the

amount of the refrigerant is small, it is possible to reduce the discharging temperature of the compressor, and the problem of the liquid compression in the compressor is not produced.

In either Suzuki nor Hiroaki, the refrigerant in the supercritical state is not returned to the compressor.

Therefore, independent claims 1 and 3 patentably distinguish over the prior art relied upon by reciting, as exemplified by claim 1,

“A refrigerator wherein at least a compressor, a radiator, a first throttle apparatus and an evaporator are connected to one another in an annular form to constitute a main circuit of a refrigeration cycle, a refrigerant which can be brought into a supercritical state by said radiator during operation is charged into said refrigeration cycle, an injection pipe branched off from a pipe between an outlet of said radiator and an inlet of said first throttle apparatus is connected to a cylinder of said compressor not via a receiver for separating gas and liquid from each other, and the refrigerant in the supercritical state is injected into said cylinder of said compressor.” (Emphasis Added)

Therefore, withdrawal of the rejection of claims 1-5 is respectfully requested.

Conclusion


In view of the aforementioned amendments and accompanying remarks, it is believed that this application is in condition for allowance, which action, at an early date, is requested.

If, for any reason, it is felt that this application is not now in condition for allowance, the Examiner is requested to contact Applicants' undersigned attorney at the telephone number indicated below to arrange for an interview to expedite the disposition of this case.

In the event that this paper is not timely filed, Applicants respectfully petition for an appropriate extension of time. Please charge any fees for such an extension of time and any other fees which may be due with respect to this paper, to Deposit Account No. 01-2340.

Respectfully submitted,

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